Cryptologic Technician Training Series

Module 23— Time Conversion

The terms training manual (TRAMAN) and nonresident training course (NRTC) are now the terms used to describe Navy nonresident training program materials. Specifically, a TRAMAN includes a rate training manual (RTM), officer text (OT), single subject training manual (SSTM), or modular single or multiple subject training manual (MODULE); and a NRTC includes nonresident career course (NRCC), officer correspondence course (OCC), enlisted correspondence course (ECC) or combination thereof.

Although the words "he," "him," and "his" are used sparingly in this manual to enhance communication, they are not intended to be gender driven nor to affront or discriminate against anyone reading *Time Conversion*, NAVEDTRA A95-23-00-88.

PREFACE

The purpose of *Time Conversion*, NAVEDTRA A95-23-00-88, is to assist enlisted and officer personnel of the United States Navy and Naval Reserve in acquiring the knowledge requisite to time computation. It uses two-dimensional charts and expanded narratives to explain the system of global division and designation and the processes and mathematical formulas used in time conversion. Although primarily oriented toward those specialties involved in intelligence gathering and interpretation, it does, nevertheless, have widespread application to many other Navy ratings and assignments.

Time Conversion is based upon the experience and practical usage of senior technicians whose Navy occupational specialties require time-zone knowledge and conversion skills. It is a training document and is not to be considered a directive.

This publication was prepared by the Naval Security Group Division of the Naval Education and Training Program Management Support Activity, Pensacola, Florida, for the Chief of Naval Education and Training.

Published by
NAVAL EDUCATION AND
TRAINING PROGRAM
MANAGEMENT SUPPORT ACTIVITY

Stock Ordering No.
0507-LP-095-2300

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON,D.C.:1988

THE UNITED STATES NAVY

GUARDIAN OF OUR COUNTRY

The United States Navy is responsible for maintaining control of the sea and is a ready force on watch at home and overseas, capable of strong action to preserve the peace or of instant offensive action to win in war.

It is upon the maintenance of this control that our country's glorious future depends, the United States Navy exists to make it so.

WE SERVE WITH HONOR

Tradition, valor, and victory are the Navy's heritage from the past To these may be added dedication, discipline, and vigilance as the watchwords of the present and the future.

At home or on distant stations we serve with pride, confident in the respect of our country, our shipmates, and our families.

Our responsibilities sober us; our adversities strengthen us.

Service to God and Country is our special privilege. We serve with honor.

THE FUTURE OF THE NAVY

The Navy will always employ new weapons, new techniques, and greater power to protect and defend the United States on the sea, under the sea, and in the air.

Now and in the future, control of the sea gives the United States her greatest advantage for the maintenance of peace and for victory in war

Mobility, surprise, dispersal, and offensive power are the keynotes of the new Navy. The roots of the Navy lie in a strong belief in the future, in continued dedication to our tasks, and in reflection on our heritage from the past.

Never have our opportunities and our responsibilities been greater.

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Naval Education and Training Program Management Support Activity

CRYPTOLOGIC TECHNICIAN TRAINING SERIES

MODULE 23
TIME CONVERSION

NAVEDTRA A95-23-00-88

1988 Edition Prepared by
CTICM Dennis R. Culbertson

CRYPTOLOGIC TECHNICIAN TRAINING SERIES

Upon its completion, the Cryptologic Technician Training Series will contain approximately 30 modules. The following list presents the titles of the available modules. You should refer to the current issue of NAVEDTRA 10061 for details regarding each module and listings of additional modules.

Module 2	The Message
Module 3	Automated Communications Systems/Introduction to Data Communications
Module 5	Satellite Communications
Module 7	Fleet Operations - Orientation
Module 8	Fleet Operations - Electronic Warfare
Module 9	Fleet Operations - Tactical Cryptologic Management
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TOPIC 1

TIME THEORY

The development of high-speed transportation and communications has reduced the relative size of the earth to the extent that people can now travel from North America to Europe in less than 3 hours; a message can be sent from any place on the earth and arrive at any other place in less than 1 second; and weapons of every description can be deployed from subsurface, surface, air, and space platforms. As this technology was emerging, it became apparent that nations could no longer think in terms of local times and conditions. A standard time reference covering the entire world was needed. Without a standard time system, a routine SST flight plan for a Paris-to-San Francisco flight might read like this:

Depart Paris -	1200 Local Time
Arrive London -	1130 Greenwich Mean Time
Depart London -	1200 Greenwich Mean Time
Arrive New York -	0950 Eastern Standard Time
Depart New York -	1050 Eastern Standard Time
Arrive Denver -	0930 Mountain Standard Time
Depart Denver -	1000 Mountain Standard Time
Arrive San Francisco -	0930 Pacific Standard Time

In computing the elapsed time for the flight, or for any part of it, individual calculations are necessary to adjust for time zone changes. There also might be

changes for Daylight Saving Time (DST) or other local differences. Time computations are easiei if all times are computed on a common worldwide basis. Then, our flight plan is simplified, looking like this:

Depart Paris - 1100 Greenwich Mean Time
Arrive London - 1130 Greenwich Mean Time
Depart London - 1200 Greenwich Mean Time
Arrive New York - 1450 Greenwich Mean Time
Depart New York - 1550 Greenwich Mean Time
Arrive Denver - 1630 Greenwich Mean Time
Depart Denver - 1700 Greenwich Mean Time
Arrive San Francisco - 1730 Greenwich Mean Time

GREENWICH MEAN TIME (GMT)

To meet the need for standardization, the inter-ıational GMT system was developed. All countries of the world adopted its use.

GLOBAL DIVISION AND DESIGNATORS

To compute time differences, you need to understand the international GMT system. In this system, the surface of the earth is divided into 24 zones, ach extending through 15 degrees of longitude, /ith the initial zone lying between longitudes -1/2 degrees east and 7-1/2 degrees west of the rime meridian. (*Longitude* is the name given to ıe imaginary lines that run lengthwise, north and uth, between the North and South Poles. They ive east and west designators.) The time sys-n is named after Greenwich, England, because e zero meridian passes directly through that own. Each zone represents a different time in the

24-hour-day cycle, with a 1-hour variation between each time zone. To further aid in zone referencing, each time zone has a numerical, a literal (letter), and, to aid in the mathematical computation, a "+" or a "−" designator.

Numerical Designators

The zero meridian (prime meridian) is the imaginary line running down the center of the initial time zone; thus, this time zone is designated "Ø" (zero) in the numbering system. The remaining zones are numbered consecutively, 1 through 12, both east and west of 7-1/2 degrees longitude, through 18Ø degrees longitude. The longitudes of 18Ø degrees east and 18Ø degrees west are the same imaginary line. This meridian is the *International Date Line* (IDL). See figure 1-1.

Let's pause to consider what appears to be a contradiction. We stated that the earth is divided into 24 time zones; however, we have accounted for 25 zones (12 east of zone Ø, 12 west of zone Ø, and zone Ø itself, a total of 25 zones). This contradiction will be resolved later in the discussion of the IDL and the requirement to have a point at which we shift from one day to another. For now, let's agree there are only 24 time zones

Literal (Letter) Designators

In addition to all zones having an assigned number, each zone also has a letter designator. The initial time zone, again because of its division by the zero meridian, is designated zone "Z", or ZULU. (Use the phonetic alphabet to render the letters of the time zones.)

With 25 designators, we use every letter of the English alphabet except "J". See figure 1-2. Like th

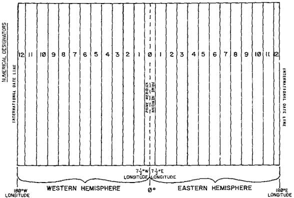


Figure 1-1.—The world.

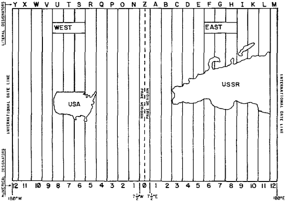


Figure 1-2.—Numerical and literal designators.

numbering system, the letters begin with the ZULU (0) time zone and progress to the east and west, consecutively. The eastern zones are lettered "A" through "M" (ALFA through MIKE) and the western zones are lettered "N" through "Y" (NOVEMBER through YANKEE).

In the past, the literal designators have been the downfall of students attempting to master time conversion. To help you remember the literal designation system, try using the following memory aid: Common sense dictates that the ALFA zone borders the ZULU zone, since ZULU is the key to the whole system, and since ALFA is the first letter of the alphabet. Now the only question remaining is whether ALFA lies to the east or to the west of ZULU. If we remember that the headquarters of the Communist world, Moscow, is in the CHARLIE time zone, the ALFA and BRAVO zones will fall naturally into place on the eastern side of ZULU. (With ZULU representing England, Moscow is to the east.) See figure 1-3. Now all we need to do is to fill in the remaining letters in alphabetical order. For the eastern hemisphere, remember to omit "J".

We can use a similar memory aid for the western hemisphere letters. We need only ask ourselves the name of the largest city, and most probable port of debarkation, when traveling from England (ZULU) to the United States. It is New York. Using the first letters of New and York, we have the literal designators for the entire western hemisphere—NOVEMBER (immediately adjacent to ZULU) and YANKEE, the westernmost zone of the western hemisphere (immediately adjacent to the IDL).

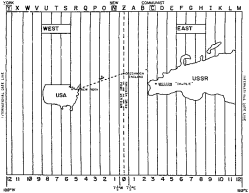


Figure 1-3.—Memory aid for the literal designation system.

Designators "+" and "−"

Each zone has a designation of either "+" or "−" in addition to the numerical and literal designators. In time-conversion computations, you will see the reason for these designators.

Learning the "+" and "−" designation system is easy. All zones of the western hemisphere have the designation "+". All zones of the eastern hemisphere have the designation "−". See figure 1-4.

PHYSICAL CHARACTERISTICS OF TIME ZONES

With the exceptions of zones MIKE and YANKEE, which we will discuss later, each time zone spans 5 degrees of longitude, with the 24 principal ieridians bisecting (dividing in half) each zone. t the equator, each degree of longitude spans Ø nautical miles (nm). Thus, a time zone spans ,ØØ nm (15×6Ø = 9ØØ).

NOTE: For the purposes of this manual, we will always ise the equator as the reference point. The natural urvature of the earth causes a narrowing of the zones s the north or south latitude increases. To use a arallel of latitude other than the equator would equire the use of advanced trigonometric formulas, nd they are beyond the scope and requirements of this ianual.

Time zones generally correspond with the principal ridians; however, sometimes they deviate from their graphical meridians, especially on land areas. This ommon along coastlines, in mountain ranges, and ng country borders. These deviations keep time istant wherever possible throughout countries,

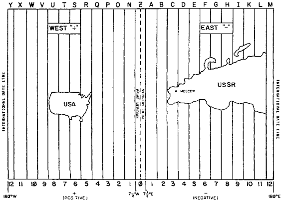


Figure 1-4.—Memory aid for the "+" and "−" designation system.

states, cities, and island chains. See figure 1-5. This is of little concern to us in the discussion of time conversion.

EXPRESSION OF TIME

The U.S. military services, as well as most foreign countries, use the international 24-hour system for expressing time. This method uses a four-digit group, with the first two digits denoting the hour, and the second two digits indicating the minutes. Thus, 6:3Ø a.m. becomes Ø63Ø; noon becomes 12ØØ; 6:3Ø p.m. becomes 183Ø. Midnight is expressed as ØØØØ, never as 24ØØ. One (1) minute past midnight is ØØØ1. The time designation 1327Z shows that it is 27 minutes past 1:ØØ p.m., GMT.

To express the day of the month along with the time, we use a six-digit group. These six digits are nothing more than a four-digit time, preceded by two digits indicating the date. This six-digit group is a *Date-Time-Group* or a *DTG*. The DTG 171327Z indicates the 17th day of the month at 1327Z.

The date element of the DTG always has two digits. This means the dates from the 1st through the 9th of the month must be preceded by a zero (Ø) to fulfill this requirement (for example, Ø11327Z, Ø21327Z, or Ø31327Z). Should a month other than the current one be intended, the standard abbreviation for the month desired follows the DTG (for example, Ø11327Z JAN, 121327Z FEB, or 211327Z MAR).

In each of the above examples, the times were expressed in ZULU time. This is to make you think in terms of ZULU, since ZULU zone time is the standard time for military communications. All messages, reports, and letters containing times use ZULU time. This enables all mobile platforms and shore stations to know at what time the subject of the

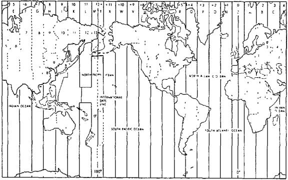


Figure 1-5.—Time zone chart of the world.

correspondence occurred. It becomes simply a matter of converting the ZULU time of the occurrence to the local time.

Obviously, there are occasions when time must be expressed as local. In these instances, the literal designator for the local zone is used in exactly the same manner as the ZULU designator was used. For example, in the UNIFORM time zone, 171327U would indicate the 17th day of the current month, 27 minutes past 1300 local time.

INTERNATIONAL DATE LINE (IDL)

The IDL divides the eastern and western hemispheres. It is an imaginary line located exactly 180 degrees east longitude and 180 degrees west longitude of the prime meridian. At this point, we must understand the special circumstances surrounding zones MIKE and YANKEE.

Each time zone has a numerical, a literal, and a "+" or a "-" designator, and zones MIKE and YANKEE are not exceptions. There is, however, a very important difference between zones MIKE and YANKEE and all other time zones. To understand this difference, look at zones MIKE and YANKEE as a single time zone of 15 degrees of longitude, half (7-1/2 degrees) in the eastern hemisphere, and half in the western hemisphere. Although the two halves of this zone share a common number (12), each half has its own literal and "+" or "-" designator. The eastern hemisphere's half is designated MIKE -12; the western hemisphere's half is YANKEE +12.

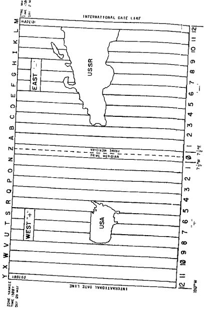
Now we come to a very important point in our discussion. Since we are considering the MIKE and YANKEE zones to be a single zone, it follows that the time in MIKE is always the same

as that in YANKEE. This is where the IDL comes into play, for whenever this line is crossed, whether from east to west or from west to east, the day must change. Since we have already established that there is a 1-hour difference between each of the 24 time zones, it is clear that there is always a situation where it is a day earlier or later in one part of the world than it is in another. See figure 1-6.

RULE: IT IS ALWAYS THE SAME TIME IN ZONE MIKE AS IT IS IN ZONE YANKEE, BUT IT IS NEVER THE SAME DAY.

A final point of contention involving the IDL and zones MIKE and YANKEE is the "gaining" or "losing" of a day as the line is crossed. If, for example, we cross from MIKE on the 10th of the month and, all of a sudden, find that it is now the 9th, did we "gain" a day (by getting to spend the 9th all over again) or did we "lose" a day (since we have to endure the 9th twice)? This is not a problem. "Gaining" or "losing" is nothing more than a question of semantics and should not be used in time-conversion conversation.

The formula for determining whether to add or subtract one day from the current day at the time of departing one hemisphere for another is: When you cross the IDL, apply the sign of the departed hemisphere. For example, to go from the MIKE zone into the YANKEE zone, subtract 1 day. MIKE is in the eastern (or the "−") hemisphere. To go from the YANKEE zone into the MIKE zone, add 1 day. YANKEE is in the western (or the "+") hemisphere. From "−" to "+", subtract; from "+" to "−", add.


INTERNATIONAL DATE LINE
USSR
USA
EAST
WEST
PRIME MERIDIAN
180°E
180°W

ZONE-TO-ZONE PROGRESSION

At this point, we will discuss one more area needed for time calculation. It is directional flow and the addition or subtraction of an hour when progressing from one time zone into another. Probably the best way to remember whether to add or to subtract the hour is to take the case of the four time zones spanned by the United States (ROMEO through UNIFORM).

Most of us have, at some time or other, watched a sporting event being played on the West Coast while we were physically located on the East Coast. In cases where the contest was held in the late afternoon or early evening in California, it was frequently dark in New York. Obviously, it was earlier in the day in California than it was in New York. Therefore, we can say with confidence that whenever traveling from a westerly direction toward a point eastward, we must add an hour each time we pass from one time zone into another. The opposite is also certainly true. When traveling from an easterly direction toward a point westward, we must subtract an hour for each new zone entered. This rule will hold true regardless of your location in the world: west to east—add, east to west—subtract. Additionally, when the 0000 hour is reached, the day changes accordingly. From west to east, the next day occurs at 0000. From east to west, the previous day occurs at 2359.

INTERIM SUMMARY

It is absolutely essential that you understand each of the points covered thus far in this manual before

attempting to convert time. The following is a short review of these principles. Test yourself. If you do not fully understand any one of them, go back and reread the related section.

1. The International Greenwich Mean Time (GMT) System was named for the town of Greenwich, England, as the town is located directly on the prime meridian, the point of departure for the entire system.

2. The surface of the earth is divided into 24 time zones, each spanning 15 degrees of longitude.

3. The initial zone is zone Ø (ZULU) and spans the area 7-1/2 degrees longitude both east and west of the prime meridian (a total of 15 degrees).

4. Each zone differs in time by 1 hour.

5. Each zone has a numerical, a literal, and a "+" or a "−" designator (exception: ZULU zone (Ø) does not have a "+" or "−" designator).

6. The zones are numbered 1 through 12, outwardly from zone Ø, throughout both the eastern and western hemispheres.

7. The zones east of ZULU are lettered ALFA through MIKE, omitting JULIETT, and each has a "−" designator.

8. The zones west of ZULU are lettered NOVEMBER through YANKEE, and each has a "+" designator.

9. There are 6Ø nautical miles (nm) in a degree; a time zone spans 15 degrees of longitude; each zone spans 9ØØ nm; and the equator is the reference point (exception: MIKE and YANKEE each span 7-1/2 degrees of longitude).

10. The U.S. Navy uses the international 24-hour time system, expressed in four digits; DTGs are formed by preceding the four-digit time with a two-digit number expressing the day.

11. The International Date Line (IDL) separates the designators MIKE and YANKEE (– 12 and + 12). The date will always change when crossing this line, regardless of the direction of crossing. When you cross the line, apply the sign of the departed hemisphere.

12. MIKE and YANKEE are one time zone of 15 degrees longitude, sharing the same numerical designator (12). MIKE is the eastern 7-1/2 degrees of longitude of this zone; YANKEE is the western 7-1/2 degrees of longitude.

13. The time will change by 1 hour whenever a new time zone is entered: east to west, subtract 1 hour; west to east, add 1 hour.

14. The day changes to the next or previous day once ØØØØ is reached, depending upon the direction of travel.

15. The time is always the same in MIKE as it is in YANKEE, but it is never the same day.

REFERENCES

Time Conversion, NAVEDTRA 10253, Naval Education and Training Program Development Center, Pensacola, Florida, 1978.

TOPIC 2

TIME-CONVERSION COMPUTATION

Communicators use ZULU time in messages and other record communications. It is extremely important that you know how to make time conversions from local to ZULU time and from ZULU to local time.

CONVERSION FROM LOCAL TIME TO ZULU TIME

We know the ZULU time zone has the numerical designator zero (Ø). At this point, the "+" or "−" assigned to each of the other zones comes into play. To convert the local time to ZULU time, simply add or subtract as indicated by the sign (+ or −) of the local time zone.

For example, we are in Pensacola, Florida, and wish to assign a Date-Time-Group (DTG) to a message. We will have to use ZULU time for the message. Pensacola is in the SIERRA time zone and is designated +6. The local date and time is 191Ø45S (the 19th of the month at 1Ø:45 a.m.). Since the SIERRA time zone is +6 (Pensacola local time), add 6 to the local time of 1Ø45. Our answer is the conversion of 191Ø45S to ZULU time − 191645Z.

Our problem looks like this:

191Ø45S	(local DTG)
+6	(Pensacola is in zone +6)
191645Z	(ZULU DTG)

NOTE: Remembeı, the +6 must be placed under the "hours" of the local DTG.

RULE: FROM LOCAL TIME TO ZULU TIME—APPLY THE SIGN.

To check ourselves for complete understanding, let's take one more example of converting local time to ZULU time. This time we are in Kamiseya, Japan, and wish to assign a DTG to an outgoing message. First, we have to know the zone designation for Kamiseya—INDIA −9. The date and time in Kamiseya is 1Ø18ØØI. Using our formula, we apply the "−" sign and subtract the local zone (9) from the local time:

1Ø18ØØI	(local DTG)
−9	(Kamiseya is in zone −9)
1ØØ9ØØZ	(ZULU DTG)

These examples can help you convert local time to ZULU time from any place in the world. The only variations that you will encounter involve the International Date Line (IDL) and Daylight Savings Time (DST), each of which will be treated separately later.

CONVERSION FROM ZULU TIME TO LOCAL TIME

The conversion from ZULU time to local time is the reverse procedure of local to ZULU. For example,

you are in San Diego, California, and receive a message from Washington, D.C. with a DTG of 1Ø18ØØZ. If you want the Washington local time of message origination, you need to know the zone designations for Washington—ROMEO +5. Then, apply the formula. Change the sign from +5 to −5 and subtract the 5 hours from the ZULU time of the message:

1Ø18ØØZ	(ZULU DTG)
−5	(Washington zone with "+" reversed)
1Ø13ØØR	(local DTG)

RULE: FROM ZULU TO LOCAL—
REVERSE THE SIGN.

To check ourselves, let's work another example of converting ZULU to local. The U.S. Ambassador to the Soviet Union has received a message from the U.S. Secretary of State concerning the latter's plans to visit Moscow. The Secretary has indicated an arrival time of 2114300Z. The Ambassador's problem is one of diplomacy: Should he arrange a luncheon or an evening meal for the arrival of the distinguished guest? We need not concern ourselves with the geographic location of the Secretary of State because he used ZULU time. However, we must know the location and designators for Moscow—CHARLIE −3. Armed with this knowledge, apply the formula. We reverse the local sign (change the −3 to a +3), and work the math:

2114300Z	(ZULU arrival time)
+3	(local zone with "−" reversed)
211730C	(local arrival time)

Forget the soup and sandwiches, he'll be there for supper.

COMPUTING TIME IN GEOGRAPHIC POSITIONS

Coordinates is a general term for numbers representing the degrees, minutes, and seconds of a geographic position. The correlation of time and geographic coordinates is a skill. Once you have learned to convert time from local to ZULU and from ZULU to local, the conversion using positional coordinates is a simple matter.

Let's consider a typical position report. A position report is normally sent as two sets of numbers. The first set of numbers is the latitude (north or south). The second set of numbers is the longitude (east or west) and is the set that we use in time conversion. (Remember, we are using the equator as the point of reference in all cases.) Normally, the longitude of a position report (the second set of numbers sent) is sent as a five-digit group. The first three digits of this group indicate the geographical degrees; the last two are the minutes. The group is followed immediately by an "E" (east) or a "W" (west) to indicate the hemisphere. For example, 115°3Ø'W indicates that the location is 115 degrees and 3Ø minutes west of the prime meridian).

There are 18Ø degrees of longitude to the west of Greenwich and 18Ø degrees longitude to the east (180°W longitude and 180°E longitude = International Date Line (IDL)—the 18Øth meridian). Each degree can be broken into 6Ø minutes.

As stated above, the five-digit longitude is normal; however, sometimes you will encounter a seven-digit longitude. This is simply a further breakdown of the minutes into seconds. One minute contains 6Ø seconds. When this occurs, the first three digits indicate degrees; the next two digits indicate minutes;

and the last two digits indicate seconds. In any event, the longitude part of a position will place the target into a specific time zone.

To determine this zone, we'll use a hypothetical position report sent in chatter: 12°35'N Ø72°42'W. We may disregard the first set of numbers (latitude) and concern ourselves only with the second set of numbers (longitude). The "Ø72°" represents the number of degrees of longitude from the prime meridian (Greenwich) and the "42' " is the number of geographical minutes from the Ø72 degree line (72nd meridian). The "W" tells us that the target is located to the west of the prime meridian, in the western hemisphere.

NOTE: Remember, a time zone spans 15 degrees of longitude, with the ZULU zone divided into 7-1/2 degrees of longitude east and 7-1/2 degrees of longitude west of the prime meridian.

The first step in our computation is to draw a graphic chart showing the western half of the ZULU time zone. Now, label the westernmost border of the ZULU time zone (7-1/2 degrees west longitude, or ØØ7°30'W). We must now continue our chart, proceeding outward from ZULU, labeling the westernmost borders of each of the time zones until we reach a point where the hypothetical longitude is equaled or exceeded.

For example, the westernmost border of zone

NOVEMBER is Ø22°3ØW (ØØ7°3Ø' + 15°);
OSCAR is Ø37°3Ø'W;
PAPA is Ø52°3Ø'W;
QUEBEC is Ø67°3Ø'W;and
ROMEO is Ø82°3Ø'W.

Once we reach the first meridian to exceed the longitude (in this case, ROMEO zone's westernmost border is the first of the westernmost borders to exceed our longitude of Ø72°42'W), we need go no further with our labeling. See figure 2-1. Longitude Ø72°42'W falls to the west of zone QUEBEC, but not past zone ROMEO. The longitude we are seeking falls within the ROMEO zone, or zone +5.

After determining the time-zone designation for our target, we apply or reverse the sign, depending upon whether we want to determine the ZULU time from local time, or the local time from ZULU time. Longitudes in the eastern hemisphere are handled in the same way, except that the easternmost borders are used instead of the westernmost borders.

Let's look at another example; this time we will establish the time-zone designators (and, therefore, longitudinal parameters). An unlocated ship sends his local time as Ø945. Your local time is 1345B. The first step in solving this problem is to convert your local time to ZULU. Use the formula, FROM LOCAL TO ZULU—APPLY THE SIGN. All you have to do is subtract your local time zone from your local time to arrive at ZULU. Zone BRAVO is −2. By subtracting the local time zone of −2 from your local time of 1345B, you arrive at ZULU time—1145Z. Since it has been established that it is 1145Z, and the ship gave his local time as Ø945, all you need to do is subtract the smaller figure from the larger. The difference will equate to the time zone of the ship.

```
  1145
− Ø945
  Ø2ØØ   (or +2 time zone)
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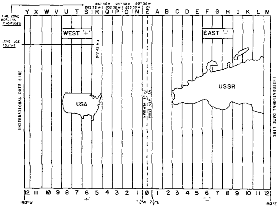

Figure 2-1.—Determining time zones from longitudinal references.

After all, if it is 1145Z in BRAVO zone, it must also be 1145Z in OSCAR and in all other zones. See figure 2-2.

COMPUTATIONS INVOLVING THE IDL

In our discussions of the IDL, we covered two very important points which bear repeating:

1. It is always the same time in zone MIKE as it is in zone YANKEE—it is never the same day.
2. When you cross the IDL, apply the sign of the departed hemisphere to determine whether to add or to subtract a day. Keep in mind that whenever we cross the line, the day must change.

To illustrate the effect that the IDL has upon a DTG, let's assume that we are flying from Tokyo to San Francisco. We begin by listing the facts that we must know about each place:

1. The time zone designators of Tokyo—INDIA −9.
2. The time zone designators of San Francisco—UNIFORM +8.
3. The date and time of departure from Tokyo—2Ø April, at Ø8ØØI.
4. The flying time is 13 hours.

THE PROBLEM: What will be the local time and date when we land in San Francisco?

To solve this problem, make a graphic chart showing each of the time zones between Tokyo and San Francisco, labeling each zone with its designators.

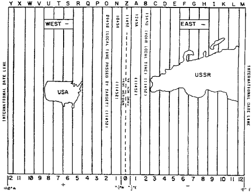

Figure 2-2.—Determining a target's zone designation.

See figure 2-3. (Don't forget to label the IDL.) Using our roughly drawn chart, let's fill in the times between Tokyo (−9) and the IDL. Since we are moving in an easterly direction, we add 1 hour upon entering each new time zone.

We have now reached the IDL and find that, before crossing the line, the local time is 201100M. We cross the line, departing −12 and entering +12. Using our formula for crossing the IDL, we apply the sign of the departed hemisphere and subtract 1 day—it is now the 19th of April. See figure 2-4. As stated before, the hour will remain the same in YANKEE (1100Y) as it was when we departed MIKE—only the day changes.

Now let's leave YANKEE and continue adding 1 hour for each new zone. Remember, it is now the 19th, NOT the 20th, as it was when we left Japan.

As we arrive in San Francisco's time zone (UNIFORM), the local time is 191500U. However, this is NOT the answer we are seeking. All we have determined thus far is that when it is the 20th of April at 0800 local time in Tokyo, it is the 19th of April at 1500 local time in San Francisco. We are not finished with the problem until we have added the flying time to the local time in San Francisco. By adding the 13 hours consumed by our flight, we find that our arrival time in San Francisco should be 200400U. If you continue to fill in each of the remaining zone times (as they would be prior to adding the 13 hours of flying time), you will see how this happens. See figure 2-4.

COMPUTATIONS INVOLVING DAYLIGHT SAVING TIME (DST)

In computing time conversions, you will frequently encounter problems where one or both

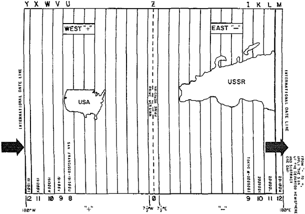

Figure 2-3.—Computations involving the International Date Line.

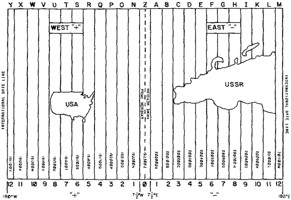

Figure 2-4.—Expansion of times for all world zones.

of the zones are using DST. Since the purpose of this time modification is to extend the daylight hours (primarily in the summer months), all we have to do is to understand what is done to establish this time.

DST is simply the setting of the clocks in a particular area ahead 1 hour, thus extending the onset of darkness by that margin. Whenever we encounter a problem involving DST, we work the problem according to the methods outlined previously, then subtract 1 hour. This will give us the normal time for that zone. If we are asked to solve a time-conversion problem for a time zone using normal time and instruced to give the answer in DST, we work the problem and add 1 hour to obtain the time in DST.

TIME-CONVERSION WORKING AIDS

Most of us have seen the back cover of *National Geographic Magazine* and its graphic display of the world with its time zones. This is a handy tool to have at hand in computing time. Obviously, though, we can't be expected to carry a magazine around in our back pocket everywhere we go. The Navy has a 4"X6" working aid, the time-conversion table. It is small enough to carry in your wallet and is readily available at most field stations. Additionally, there are many different kinds of commercially produced materials of varying degrees of value to those involved in time conversion.

TIME-CONVERSION TABLE

The time-conversion table has 24 vertical columns depicting the 24 hours of the day, and 25 horizontal

rows showing the 25 time zone designators. See table 2-1. Notice that zones MIKE and YANKEE are identical, with the exception of the day.

To use the time-conversion table, find the zones in question along the horizontal row at the bottom of the table and go up the vertical column of the known time zone. Then find the corresponding vertical position of the unknown zone. You now have the time of the unknown zone in relation to the known zone. It's as simple as that.

COMMERCIAL TIME-CONVERSION AIDS

The commercially produced time-conversion aids, primarily designed to aid the tourist, are inadequate for military and communications use. They generally emphasize central and unrelated cities of the world and disregard zone designators and the computation processes. Figure 2-5 shows a typical tourist-oriented, time-conversion aid and is included in this manual only as an example of these aids.

We have discussed time-conversion working aids only to advise you that there are shortcuts. There are no shortcuts to professionalism, however, and each of the time-conversion aids has its shortcomings. Did you notice that the time-conversion table is of no help in establishing positional locations of targets? Additionally, if you are on a direct-support platform, at an isolated duty station where the time conversion table is not available, or where supplies of the working aid are exhausted, the success of your mission might well depend upon your ability to compute time.

Table 2-1.—Time-Conversion Table

PREVIOUS DAY	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	SAME DAY
	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	
	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	
	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	
	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	
	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	
	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	
SAME DAY	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	NEXT DAY
	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	
	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	
	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	
	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	
	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1200	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	
	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	
	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	
	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	
	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	
	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	
	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	
	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	
	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	
	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	
	1600	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	
	1700	1800	1900	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	
	Y	X	W	V	U	T	S	R	Q	P	O	N	Z	A	B	C	D	E	F	G	H	I	K	L	M	
	+12	+11	+10	+9	+8	+7	+6	+5	+4	+3	+2	+1	0	−1	−2	−3	−4	−5	−6	−7	−8	−9	−10	−11	−12	

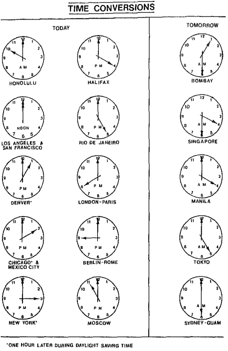

Figure 2-5.—Typical commercial time-conversion aid.

TOPIC SUMMARY

If any one of these areas is unclear to you, go back to the discussion and master that procedure.

1. To determine ZULU time from local time, apply the sign ("+" or "–") and add or subtract the numerical designator to or from the local time's hours.

2. To determine local time from ZULU time, reverse the sign ("+" or "–") and add or subtract the new numerical designator to or from the ZULU time's hours.

3. In problems involving geographical positions:

   a. Disregard the latitude; use only the longitude.

   b. Use all five digits of the longitude (seven digits, if given).

   c. Proceed in an easterly or westerly direction from the prime meridian, according to the "E" or "W" designation.

   d. Make a rough, graphic chart to establish the zone in which a given longitude falls.

      (1) Enter the longitudinal coordinates for the ZULU zone (ØØ7°3Ø'E or ØØ7°3Ø'W).

      (2) When traveling from the easternmost or westernmost border of zone ZULU, add 15 degrees for each new zone; place this new longitudinal coordinate at the easternmost or westernmost meridian of the zone, as required.

   e. Solve the time problem like any other problem after placing the target into the zone corresponding to its longitudinal coordinates.

4. In problems involving the use of a target's local time to establish its longitudinal parameters:

   a. Convert your local time to ZULU.

   b. Work from ZULU time to derive the local time of the target.

c. Place the target within its geographic zone once the local time is determined.

5. In problems involving the International Date Line (IDL):

a. Separate the MIKE and YANKEE zones.

b. Label both "+" and "−" designators (MIKE is "−"; YANKEE is "+").

c. It is always the same time in MIKE as it is in YANKEE, but never the same day.

d. The day must change each time the IDL is crossed.

e. Apply the sign of the departed hemisphere when crossing the line to determine whether to add or to subtract a day.

6. In problems involving Daylight Saving Time (DST):

a. When time is given in DST, work the problem in normal fashion, then subtract 1 hour to arrive at the zone's normal time.

b. When the zone's normal time is given, work the problem in the usual fashion, then add 1 hour to determine DST.

REFERENCES

Time Conversion, NAVEDTRA 10253, Naval Education and Training Program Development Center, Pensacola, Florida, 1978.

☆ U. S. Government Printing Office: 1988 - 530-012 (85102)